Low-Noise Technologies

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PRESS RELEASE – FOR IMMEDIATE RELEASE

Low-Noise Amplifier Device Provides Sensitivity for Next-Generation Radio Telescopes

DERBY, Kans., September 8, 2012 – Low-Noise Technologies has developed an ultralow-noise uncooled amplifier device to provide receiver sensitivity needed for next-generation radio telescope instruments and other leading scientific applications. Accompanying this amplifier development are commensurate advancements in noise measurement and network noise theory.

Low-Noise Technologies believes that its amplifier performance is key to the success of future radio telescopes such as the international Square Kilometer Array (SKA) and China's Five-hundred-meter Aperture Spherical Telescope (FAST). "Using our 3 K noise temperature uncooled device, system noise approaching 10 K is possible with proper antenna array element design and architecture," explained James Dietrich, principal investigator at Low-Noise Technologies. "This represents a significant noise advantage compared to the present 38 K design of SKA midband aperture array."

The benefits of a low-noise system design can be realized in two ways: 1) reduced construction and operating costs, and 2) increased *survey speed,* the rate at which observational data is collected by the instrument. With SKA, the midband array size can be reduced up to 70 percent with an energy cost savings alone of $35 million per year. On the other hand, if array size is maintained, survey speed is increased by factor 10. "The low-noise design with higher survey speed is compelling," Dietrich said. "After all, who would not prefer to acquire in years rather than decades astronomical data that could unravel mysteries of the Universe?"

In support of the amplifier work, Low-Noise Technologies has developed advanced noise measurement methods and network noise theory. Conventional noise measurement relies on a thermal noise reference at levels much too great for amplifiers approaching the quantum limit of sensitivity. The reference level of the new system is the quantum unit of one photon. "Since the equivalent input noise of our 3 K amplifier is 45 photons at 1.4 GHz, measurement with the new system is very fast and accurate—so much so that traditional methods are obsolete for these low-noise devices," said Dietrich.

Network noise theory describes the macro-behavior of electronic devices and systems, including low-noise amplifiers operating above the quantum noise limit. Low-Noise Technologies has completed the theory of linear noisy twoports, a large part of which had remained unsolved since the late 1950s. Unifying relationships between fundamental physical quantities called *network invariants* have been identified, and constraints on the value of invariants have been proven to exist in the important special case of low-noise amplifiers. "On our website, we have published a detailed overview and discussion of principal noise theory results, including application to SKA array optimization." Low-Noise Technologies is found at http://www.low-noisetechnologies.com.

Low-Noise Technologies is an R&D lab providing world's most advanced noise technology.

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